Thiele et al. Applied Network Science (2019) 4:7
https://doi.org/10.1007/s41109-019-0118-3

Applied Network Science

RESEARCH Open Access

Quid pro quo? The benefit of reciprocity, multiplexity, and multireciprocity in early career peer support

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Abstract

In the early career phase of higher education, the social relationships with peers are a critical source of developmental support. Peer support relationships tend to be reciprocal and multiplex, such that the actors of the relationships both give and receive multiple facets of developmental support from one another. However, reciprocity and multiplexity alone cannot cover ties that are anti-aligned across the layers of the multiplex network (i.e., one type of support received, and another type of support given in exchange). Therefore, the goal of this study is to integrate reciprocity and multiplexity in order to give consideration to such real-world multilayer relationships. We transferred the approach on multireciprocity introduced by Gemmetto et al. (Phys Rev E 94: 042316, 2016) to weighted network data of 61 university students and explored the possible beneficial effect of reciprocity, multiplexity, and multireciprocity in terms of career outcomes (i.e., objective performance, subjective performance, satisfaction with life). Results revealed no general benefit of mutuality and balance in support relationships. Rather, positive effects emerged for specific constellations of mutuality and support types. Career support in combination with socioemotional support showed to be particularly relevant for early career factors.

Keywords: Reciprocity, Multiplexity, Multireciprocity, Early career, Peers, Support network

Introduction

With the early career phase (i.e., at university) being loaded with more transitions and career-related decisions than any later career stage (Caspi 2002; Hartung et al. 2005; Shulman and Nurmi 2010), young people's need for orientation, guidance and support is particularly high (cf. Jordan and Kauffeld 2018). In this process, the social relationships with peers are a valuable source of multiple types of developmental assistance (Murphy and Kram 2010; Sacerdote 2001) because there are no classic supervisors, co-workers, or subordinates during higher education, yet. Peers are easily available (as compared to formal mentors) and find themselves in similar career-related situations (as compared to parents or school friends; Dennis et al. 2005). Accordingly, peer support relationships have been linked positively to career outcomes such as academic performance (Dennis et al. 2005; Thiele et al. 2018) and satisfaction with life (Kong et al. 2015). However, support exchange is a complex collective phenomenon comprising systemic effects which makes it necessary to employ a more systemic rather

than a sole individual-centred perspective. Applying complexity science methods such as social network analysis to such relevant aspects of life may provide further insights into the topic (see e.g. Helbing et al. 2015, for a recent review on how complexity science can contribute to our understanding of complex real-life aspects).

What makes peer support so complex is that one central aspect of peer support relationships is that they are likely to be reciprocal (Kram 1985), such that the actors both give and receive support in a relationship. Reciprocity therefore considers pairs of directed ties that are either binary (present and absent) or weighted (e.g., by frequency or strength; Squartini et al. 2013).

A second central aspect is that peer support relationships are rarely one-dimensional. Rather, they are likely to be multiplex (Kram 1985), such that a single relationship comprises various types of support exchanged between the actors (Dobrow et al. 2012; Rodkin and Ryan 2012). This multiplexity can be mapped by incorporating layers into the social support network, one for each different support type (Gemmetto et al. 2016).

The layers of the resulting multiplex of networks are very likely to be dependent on one another (Gemmetto et al. 2016). When layers are interdependent, however, a new type of relationship emerges that is neither covered by reciprocity nor multiplexity: Ties that are anti-aligned across layers, meaning that the outgoing tie is in one layer and the corresponding ingoing tie is in another. This multiplex reciprocity ("multireciprocity", Gemmetto et al. 2016), could offer new, potentially valuable insights into support networks. So far, however, this approach has not been yet applied in this field of research.

We posit that considering reciprocity, multiplexity, and multireciprocity when examining support networks covers the three possible patterns of directed ties within any multi-layered network multiplex: reciprocated ties, multiplex ties, and cross-layer reciprocated (i.e., multireciprocated) ties. Following this argument, the question arises as to how mutuality in support relationships, whether (1) reciprocated, (2) multiplex, or (3) multireciprocated has positive outcomes in terms of career development (e.g., objective and subjective performance). Moreover, considering weighted relationships, balance in support exchange (i.e., giving and receiving equal amounts of support in a relationship) might play a crucial role here. Extending previous research, the goal of this study is to explore possibly beneficial patterns of mutuality and balance in peer support relationships. With this study, we generate new knowledge on social support exchange by showcasing a new array of tools with which to examine feature-rich networks.

Reciprocated peer support

Reciprocity with regards to social support in general has been studied thoroughly. In this context, reciprocity is not only a characteristic of a social relationship also a moral norm to avoid exploitation (cf. Gouldner 1960). In the context of support, reciprocity has been linked to positive manifestations of relevant outcomes (e.g., performance, Vaquera and Kao 2008), whereas imbalanced support has been linked to, e.g., lower perceived career success (Higgins et al. 2008) and negative affect (Buunk et al. 1993).

A particularly important aspect of reciprocity of feature-rich networks such as support networks is balance. Considering weighted ties, balance considers the *amount* of benefits (e.g., support) given versus those received in a relationship. Adam's (Adams

1965) theory of inequity in social exchanges posits that reciprocity requires balance. Under- but also over-benefiting would have negative consequences for the person concerned, resulting in feelings of anger or guilt, respectively (Adams 1965). Additionally, both giving and receiving support comes with psychological costs. Only a balance in giving and receiving support will keep psychological costs for the individual at an acceptable level (Maton 1987). Balanced reciprocity (i.e., giving the same amount of benefits as one receives) has been found to be linked to higher well-being, with deviations from balance in either direction both associated with in poorer health or well-being outcomes (Jou and Fukada 2002; Li et al. 2011; Liang et al. 2001). Support research, however, has not yet touched upon balanced reciprocity with regards to performance or life satisfaction which are central aspects of early careers. To address this, we aim to examine:

Research question 1: How is balanced reciprocal support in a person's peer network linked to a) objective performance, b) subjective performance, and c) satisfaction with life?

Multiplex peer support

Multiplexity is considered an indicator of higher tie strength (Beckman and Haunschild 2002). Beyond that, we argue that multiplexity could exceed the concept of tie strength and provide individuals with means to match the benefits obtained from their relationships to their needs, ultimately leading to more efficient networks (Higgins 2007). Results from a study with MBA students showed that different types of support (i.e., career & psychosocial support) were associated with higher career satisfaction (Murphy and Kram 2010). Moreover, multiplex support has also been associated with actual increased work performance, possibly because it has enabled individuals to systematically address knowledge which in turn has helped them to perform (Claro et al. 2012). We transfer this reasoning with regards to peer support networks in higher education and aim to examine:

Research question 2: How is multiplex support in a person's peer network linked to a) objective performance, b) subjective performance, and c) satisfaction with life?

Multireciprocated peer support

Multireciprocity has not yet been applied to any other context than an economic one (Gemmetto et al. 2016). However, it might prove useful in studying reciprocal ties in multiplex support networks. While reciprocity covers only returning the same kind of support and multiplexity covers only one (though multi-dimensional) support direction, multireciprocity combines both approaches and would therefore allows researchers to study established support relationships that match the actors' individual needs and their available resources, which in turn is held to be the most beneficial characteristic of a network (Higgins 2007). Moreover, we argue that this approach is most suitable to consider real-world multilayer relationships such as support relationships. Therefore, we aim to examine:

Research question 3: How is balanced multireciprocal support in a person's peer network linked to a) objective performance, b) subjective performance, and c) satisfaction with life?

Method

Sample and procedure

This study was conducted in a cohort of 63 bachelor psychology students at a German public university who were at the end of their forth semester. A final sample of 61 students participated in the data collection via paper-pencil questionnaires. As is typical for psychology students, the sample consisted largely of females (83.6%) with an average age of 23.3 years (SD = 5.06, range = 20–49). Upon submitting the questionnaires, students were credited for their participation in the study with test-person credits, which they needed to collect during their studies for their degree.

Measures

Support network

The students were asked to indicate from which fellow students on an exhaustive name list of all students in the cohort they had sought socio-emotional, subject-related, and career-related support in the past two semesters. For each type of support, several examples were provided to give students an idea what constitutes as socioemotional, subject-related, or career support. In this connection, they were instructed to rate the extent to which the statement "I seek … -support from ... (e.g., …)" described their relationships on a 5-point Likert-type scale (*not true*, *rather not true*, *in part*, *rather true*, *true*). While participants only saw the verbal description of each scale level, numerical values were assigned in ascending order at data entry with *not true* assigned to 0 and *true* to 4. This was necessary as the methods used to obtain reciprocity, multiplexity, and multireciprocity require absent ties to be coded as 0 and present ties as ≥1 (Gemmetto et al. 2016; Squartini et al. 2013).

Objective academic performance

Objective academic performance was measured by asking the participants "What is your current grade point average (GPA; e.g., 2.3)?" In the German university system, grades are scored in reverse, from 1 (*excellent*) to 5 (*failed*), Consequently, smaller values correspond to better grade point averages.

Subjective academic performance

Subjective performance was measured with the Academic Self Concept Scales (Dickhäuser et al. 2002) with an absolute (5 items, e.g., "I find learning new things … *difficult*/ *easy*."), a criterion-based (5 items, e.g., "Considering the requirements of the studies, I find learning new things … *difficult*/ *easy*."), and a social frame of reference (6 items, e.g., "Compared to my peers, I find learning new things … *difficult*/ *easy*.") on a 7-point scale ranging from 1 to 7.

Satisfaction with life

Current satisfaction with life was measured with the Temporal Satisfaction with Life Scale (Pavot et al. 1998) in the German version (Trautwein 2004; 4 items, e.g., "I'm satisfied with my present life.") with a 6-point Likert-type scale from 1 (*completely disagree*) to 6 (*completely agree*). Table 1 provides information on the descriptives and intercorrelation of the used measures.

Analytic strategy

We computed the individual rate of reciprocity using the procedure proposed by Squartini et al. (2013) and the individual rate of multiplexity and multireciprocity using the approach introduced by Gemmetto et al. (2016). Although these three measures could also be considered globally in terms of the whole network or locally on the dyad level, we consider all of these measures solely as individual (i.e. ego-specific) according to our research questions. That is, dyadic-specific measures are only used as intermediate steps to compute individual values in this study (cf. Squartini et al. 2013). To illustrate the mathematical procedures throughout this section, Fig. 1 depicts an exemplary network, consisting of one focal student i and two peers, j_1 and j_2. Subsequently, we ran multiple correlations with the outcome measures.

Rate of individual reciprocity

To compute the individual rates of weighted reciprocity in each student's support network with the approach introduced by Squartini et al. (2013), tie weights were split into a balanced (i.e., fully reciprocated) and an imbalanced (i.e., non-reciprocated) part for each network layer. For the balanced part, the fully reciprocated tie weight (minimum) was determined. For the imbalanced part, the weight of one tie was subtracted from the weight of its counterpart (Squartini et al. 2013). To give an example, we consider the network in Fig. 1 with $N = 3$ actors and denote $i = \{1, \ldots, N\}$ as a ego and $j = \{1, \ldots, N \mid j \neq i\}$ as alter. If the focal student i often approached peer j_1 for socioemotional support, this tie b_{ij} would assume the value 3. Peer j_1 approached i only rarely for socioemotional support, meaning the corresponding tie b_{ji} would assume the value 1. The balanced part of their relationship then would be 1, while the imbalanced one would be 2. Mathematically, this translates into the following two equations:

$$\text{reciprocated tie weight } b_{ij}^{\leftrightarrow} = \min\left[b_{ij}; b_{ji}\right] \tag{1}$$

Table 1 Means, Standard Deviations, Ranges, and Intercorrelations of Used Measures ($N = 61$)

Measure	Mean	SD	Range	1	2a	2b	2c	3
1. Objective performance (GPA)	1.74	0.42	3.0–1.1	–				
2. Subjective performance								
a) absolute	5.25	0.77	2.2–6.6	−.38**	(.84)			
b) criterion-based	4.96	1.04	1.2–6.6	−.42**	.86**	(.93)		
c) social	4.15	0.95	1.0–5.8	−.31*	.77**	.79**	(.92)	
3. Satisfaction with life	4.68	0.83	2.5–6.0	−.09	.30*	.20	.25	(.87)

Note. Two-tailed Pearson's correlations. Internal consistencies (Cronbach's alpha) appear on the diagonal
*$p < .05$; **$p < .01$

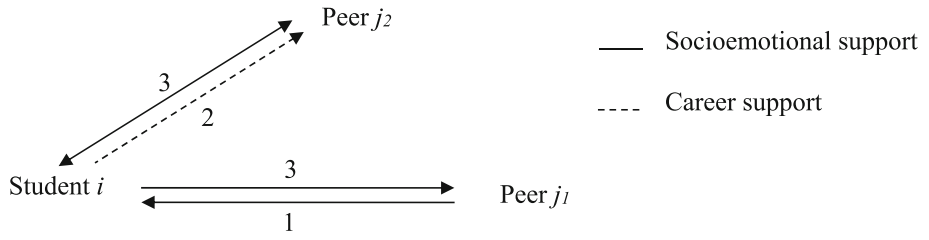

Fig. 1 Exemplary network of fictional student *i*, reduced to two peers and two network layers, numbers represent tie weights

$$\text{non–reciprocated tie weight } b_{ij}^{\rightarrow} = b_{ij} - b_{ji} \tag{2}$$

Concerning the non-reciprocated tie weights $b_{ij}^{\rightarrow}$, a positive value would mean that *i* seeks support from *j* more often than *j* seeks support from *i*. The reverse would be the case if $b_{ij}^{\rightarrow}$ was negative. In the case of perfect reciprocity, $b_{ij}^{\rightarrow}$ would be zero.

As a first step toward scores of balance and imbalance of each student's entire network concerning one particular layer (e.g., socioemotional support), these calculations were performed for all tie pairs of a student, resulting in a set of vectors comprising the sum of weights on the individual actor level. Mathematically, this would be expressed through the following set of equations (as proposed by Squartini et al. 2013):

$$\text{individual reciprocated strength } s_i^{\leftrightarrow} = \sum\nolimits_{j \neq i} b_{ij}^{\leftrightarrow} \tag{3}$$

$$\text{individual in–strength } s_i^{in} = \sum\nolimits_{j \neq i} b_{ji} \tag{4}$$

$$\text{individual out–strength } s_i^{out} = \sum\nolimits_{j \neq i} b_{ij} \tag{5}$$

$$\text{individual non–reciprocated in–strength } s_i^{\leftarrow} = s_i^{in} - s_i^{\leftrightarrow} \tag{6}$$

$$\text{individual non–reciprocated out–strength } s_i^{\rightarrow} = s_i^{out} - s_i^{\leftrightarrow} \tag{7}$$

If, considering socioemotional support in the abovementioned example (see Fig. 1), the tie weight from student *i* to peer j_1 was 3 while the corresponding tie from j_1 to *i* was 1, and both the tie from *i* to another peer j_2 as well as its corresponding tie from j_2 to *i* were 3, the three equations would thus return the following results:

$$s_i^{\leftrightarrow} = \begin{pmatrix} \min(3;1) \\ \min(3;3) \end{pmatrix} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} s_i^{\leftarrow} = \begin{pmatrix} 1-1 \\ 3-3 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} s_i^{\rightarrow} = \begin{pmatrix} 3-1 \\ 3-3 \end{pmatrix} = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$$

Subsequently, the reciprocated and total tie weights are summed up for the entire network of *i*. The base of calculation for the total tie weight depends on the frame of reference: for example, if the relation between reciprocated ties compared to all outbound ties is of interest, the sum of all outbound tie weights is used. Finally, the rate of reciprocated to total tie weight is calculated (Squartini et al. 2013):

$$\text{sum of reciprocated tie weight per person } B_i^{\leftrightarrow} = \sum s_i^{\leftrightarrow} \tag{8}$$

$$\text{sum of total inbound tie weight per person } B_i^{in} = \sum s_i^{in} \tag{9}$$

$$\text{sum of total outbound tie weight per person } B_i^{out} = \sum s_i^{out} \tag{10}$$

$$\text{rate of reciprocated inbound tie weight per person } rec_i^{\leftarrow} = \frac{Bi^{\leftrightarrow}}{B_i{}^{in}} \tag{11}$$

$$\text{rate of reciprocated outbound tie weight per person } rec_i^{\rightarrow} = \frac{Bi^{\leftrightarrow}}{B_i{}^{out}} \tag{12}$$

A huge advantage of this approach is that it considers the *relative* (im) balance of ties, such that especially imbalances are not overestimated: Depending on the individual tie weights, an imbalance of 4 could be either quite substantial if tie weights can only assume relatively small values (as is the case in this study) or entirely negligible if tie weights can be large, for example in a pair of ties weighted 100 and 104, respectively. Moreover, this method is applicable to both binary and weighted data (Squartini et al. 2013). Considering our research question, we measured reciprocity within the weighted interpretation of our network data.

Rate of individual multiplexity

The individual rate of multiplexity in each student's support network, as proposed by Gemmetto et al. (2016), were computed in a similar manner to that for obtaining the rate of reciprocity, with only slight differences to allow for the consideration of two network layers. Instead of the reciprocated tie weight, the rate of multiplexity considers ties in layer α which are multiplexed in another layer β. For example, a tie b would be multiplexed if student i seeks both career and socioemotional support from peer j_2 (see Fig. 1), meaning the tie would be multiplexed in the socioemotional and career layer of the support network multiplex.

As with reciprocity, the minimum multiplexed tie weight for each pair of ties for any pair of layers is summed up for each student, yielding the total multiplexed tie weight. This is then compared to the total tie weights of both network layers. Because the total tie weight is comprised of two values, the minimum multiplexed tie weight then must be multiplied by 2 in order to correct and balance the equation. If left uncorrected, the rate of multiplexity in a fully-multiplexed network would be limited to 0.5 (or 50%). The mathematical expression would therefore be (Gemmetto et al. 2016):

$$\text{rate of multiplexity } mp_i^{\alpha,\beta} = \frac{2\sum_{j\neq i} \min\left\{b_{ij}^{\alpha}, b_{ij}^{\beta}\right\}}{\sum_{j\neq i} b_{ij}^{\alpha} + \sum_{j\neq i} b_{ij}^{\beta}} \tag{13}$$

This approach is applicable for both binary and weighted data, too. However, considering weighted multiplexity, a tie is only considered fully multiplexed if the tie weights are exactly the same. While the implications of weighted multiplexity with regards to trade relationships are fairly clear (that is, commodities with higher weighted multiplexity tend to be traded together in similar amounts; Gemmetto et al. 2016), the same cannot be said of support relationships. For each individual, it is not clear whether different (mathematical) values of weighted multiplexity (e.g., 0.8 compared to 0.5 and 1.0) result in any difference for the individual. Because the focus of this study was to examine whether multiplexity in general (i.e., the access to multiple types of support from one alter, which do not have to be balanced to meet the individual's needs)

predicts career outcomes, we chose to consider the rate of multiplexity within the binary interpretation of our network data.

Rate of individual multireciprocity

The individual rate of multireciprocity in each student's support network was determined by using the approach of Gemmetto et al. (2016), with the only difference to the previous approach being that it considers pairs of anti-aligned ties instead of two aligned ties in two network layers. For example, a tie would be considered multireciprocated if student i would seek career support from peer j_2, while j_2 would seek socioemotional support from i.

Accordingly, the minimum tie weight of a pair of ties is determined by considering the minimum of the tie from i to j in layer α and its counterpart, the tie from j to i in layer β. Again, all minima for each pair of ties of each student are summed up, multiplied by 2 to offset the previous halving of the total number of values, and then divided by the total tie weight for both layers. Considering the exemplary network, the tie weight from i to j_2 in the career support layer equals 2; the tie weight from j_2 to i in the socioemotional support layer equals 3. This minimum of 2 multiplied by 2 equals 4, while the total tie weight of both layers equals 5. The rate of multireciprocity for career support in exchange for socioemotional support therefore is 0.8. Mathematically, this is represented by the following equation (Gemmetto et al. 2016):

$$\text{rate of multireciprocity } \mathrm{mr}_{\mathrm{i}}^{\alpha,\beta} = \frac{2\sum_{j\neq i} \min\left\{b_{ij}^{\alpha}, b_{ji}^{\beta}\right\}}{\sum_{j\neq i} b_{ij}^{\alpha} + \sum_{j\neq i} b_{ij}^{\beta}} \tag{14}$$

This approach is again suited for both binary and weighted data. To answer our research question, we measured multireciprocity within the weighted interpretation of our network data. The used syntax for computing the network measures and a fictitious data set of five students that illustrates our sample are attached as Additional file 1.

Descriptives and hypothesis tests

All analyses were run using R (version 3.3.3) using R's basic toolbox, the data.table syntax (available through the data.table package, Dowle 2019, and the corr.test function of the R package psych, Revelle 2019). To avoid overcorrection concerning the multiple correlations in corr.test, inbuilt adjustment was turned off. To avoid α-inflation α-levels were set at .01 for each predictor in an a-priori Bonferroni-type correction. Reflecting the tentative nature of the hypotheses, two-tailed calculations were conducted.

Results

Descriptive overview

Table 2 shows basic descriptive results for the network measures. We observe that the rate of reciprocity is highest when socioemotional support is involved, while career support networks tend to be less reciprocal. The means show, for example, that 67% of all socioemotional outbound ties (i.e., the support a student seeks from their peers), are reciprocated equally.

On average, roughly two-thirds of the ties in any given layer were multiplexed in another, meaning that around two-thirds of any two layers overlap. If multiplexity is considered an indicator of tie strength (Beckman and Haunschild 2002), these results would suggest that networks consist to a large extend of strong ties.

The rate of balanced multireciprocity is generally lower than that of reciprocity. However, the rate of balanced multireciprocity is highest as well when socioemotional support is involved. The means show, for example, that 47% of all socioemotional outbound support ties (i.e., support sought) and all subject-related inbound support ties (support asked for) are multireciprocated equally for one another.

Correlation of mutuality and career outcomes

All correlations are reported in Table 3. While most correlations range between $r = -.10$ and $r = .10$, meaning their effect size is negligible, several correlations are comparatively large, ranging around medium effect size (exceeding $r = |.30|$; Cohen 1988).

Balanced support reciprocity and career outcomes

For research question 1, we examined how the rate of reciprocal support was related to objective and subjective performance as well as to satisfaction with life. Regarding the

Table 2 Means, Standard Deviation and Range for Rates of Reciprocity, Multiplexity and Multireciprocity

Network parameter	Mean	SD	Range
Rate of reciprocated outbound support			
Socioemotional	0.67	0.22	0.00–1.00
Subject-related	0.56	0.20	0.17–1.00
Career	0.48	0.26	0.00–1.00
Rate of reciprocated inbound support			
Socioemotional	0.59	0.22	0.00–0.97
Subject-related	0.49	0.20	0.07–0.95
Career	0.42	0.28	0.00–0.95
Rate of multiplex support			
Socioemotional & subject-related	0.68	0.23	0.00–1.00
Socioemotional & career	0.65	0.30	0.00–1.00
Subject-related & career	0.66	0.28	0.00–1.00
Rate of multireciprocated support			
Socioemotional for subject	0.47	0.18	0.00–0.83
Socioemotional for career	0.48	0.19	0.00–0.91
Subject for socioemotional	0.51	0.18	0.00–0.85
Subject for career	0.42	0.18	0.00–0.72
Career for socioemotional	0.44	0.23	0.00–0.80
Career for subject	0.36	0.21	0.00–0.80

Note. Rate of reciprocated outbound support = the amount of X-support ego exchange mutually with their alters compared to the overall amount of X-support ego seeks from their alters. Rate of reciprocated inbound support = the amount of X-support ego exchanges mutually with his/her alters compared to the overall amount of X-support their alters seek from ego. Rate of multiplex support = the proportion of X-support that ego combined with Y-support seeks from their alters compared to the overall support ego seeks with regard to X- and Y-support from his/her alters. Rate of multireciprocated support = the amount of X-support ego seeks in exchange for Y-support from their alters compared to the overall X-support ego seeks from his/her alters and the Y-support their alters seek from ego

Table 3 Correlations of Rates of Reciprocity, Multiplexity and Multireciprocity with Career Outcomes

Network parameter	GPA	Subjective performance			Satisf. with life
		Abs.	Crit.	Soc.	
Rate of reciprocated outbound support					
Socioemotional	.13	−.18	−.24	−.19	−.14
Subject-related	−.27	.01	.07	.01	−.31**
Career	−.19	−.17	−.13	−.07	−.19
Rate of reciprocated inbound support					
Socioemotional	−.09	.02	.00	.05	.09
Subject-related	−.04	.08	.08	.14	.06
Career	−.35**	.10	.12	.13	.06
Rate of multiplex support					
Socioemotional & subject-related	−.25	.09	.14	.14	.24
Socioemotional & career	−.37**	−.01	.06	.02	.06
Subject-related & career	−.33	.02	.06	−.04	.07
Rate of multireciprocated support					
Socioemotional for subject	−.14	.14	.12	.12	.15
Socioemotional for career	−.16	.10	.08	.09	.07
Subject for socioemotional	−.22	−.04	−.03	.13	−.06
Subject for career	−.25	−.04	.02	.09	−.25
Career for socioemotional	−.38**	−.04	.01	.07	−.01
Career for subject	−.32	.05	.08	.10	.02

Note. Subjective performance with three frames of reference: *abs* absolute (in general), *crit* criterion-based (compared to requirements of the studies), *soc* social (compared to peers), *GPA* German Grade point average (lower values = better grades). Rate of reciprocated outbound support = the amount of X-support ego exchange mutually with their alters compared to the overall amount of X-support ego seeks from their alters. Rate of reciprocated inbound support = the amount of X-support ego exchanges mutually with their alters compared to the overall amount of X-support their alters seek from ego. Rate of multiplex support = the proportion of X-support that ego combined with Y-support seeks from their alters compared to the overall support ego seeks with regard to X- and Y-support from their alters. Rate of multireciprocated support = the amount of X-support ego seeks in exchange for Y-support from their alters compared to the overall amount of support ego seeks with regard to X- and Y-support ego seeks from their alters

** $p < .01$, two-tailed

rate of reciprocal outbound support (i.e., the amount of support ego exchanges mutually with their alters compared to the overall amount of support ego seeks from their alters), we observe a significant (but negative) correlation only in terms of subject-related support and satisfaction with life ($r = -.31$, $p < .01$). That is, the more peers seek same amounts of subject-related support from a student as they seek from their peers, the less the student is satisfied with their current life.

With respect to reciprocal inbound support (i.e., the amount of support ego exchanges mutually with their alters compared to the overall amount of support their alters seek from ego), we find a significant correlation regarding career support and grades ($r = -.35$, $p < .01$). That is, the more a student seeks same amounts of career support from their peers as peers seek from them, the better they objectively perform in studies (i.e., better grades).

For perceived performance, no significant associations with the rate of reciprocity for any support type were observed. Generally, when comparing the (also non-significant) correlation coefficients of inbound with those of outbound reciprocity rates, we find a tendency for outbound support reciprocity rates toward negative manifestations of

outcomes while the reverse pattern emerged for inbound support reciprocity rates. Balanced reciprocity therefore appears to be more beneficial with regards to inbound support.

Support multiplexity and career outcomes

For research question 2, we examined how the rate of multiplex support was related to objective and subjective performance as well as to satisfaction with life. We find a significant correlation of multiplex relationships offering socioemotional as well as career support (i.e., the amount of combined socioemotional and career support that ego seeks from their alters compared to the overall socioemotional and career support ego seeks from their alters) with grades ($r = -.37$, $p < .01$). That is, the more a student seeks combined career and socioemotional support from their peers, the better their grades. For subjective performance as well as satisfaction with life, no significant associations with the rate of multiplexity was observed, thus, there seems to be no general benefit in multiplex support ties compared to one-dimensional ones.

Balanced support multireciprocity and career outcomes

For research question 3, we examined how the rate of multireciprocated support was related to objective and subjective performance as well as to satisfaction with life. We did so to uncover beneficial patterns of balanced anti-aligned support exchange of different types for the first time, as these might yield important insights into such a real-world feature-rich network. We observe a significant correlation of the rate of multireciprocated support in terms of outbound career support with inbound socioemotional support (i.e., the amount of career support ego seeks from their alters in exchange for socioemotional support compared to the amount of overall career support ego seeks from their alters and of the socioemotional support their alters seek from ego) with grades ($r = -.38$, $p < .01$). That is, the more a student seeks career support in exchange for socioemotional support, the better their grades. When looking at the direct counterparts of this pattern, interestingly, there is no such correlation concerning outbound career support and inbound subject-related support, nor concerning outbound socioemotional support and inbound career support. Additionally, for subjective performance as well as satisfaction with life, no significant associations with the rate of multireciprocated ties could be observed. In line with the other results from this study, multireciprocity may have particular benefits but no general one.

Discussion

The present study exploratively examined whether multi-dimensional mutuality and balance in early career peer support networks could foster critical career outcomes. To gain first indications to such effects we used the approach of Gemmetto et al. (2016) to integrate reciprocity and multiplexity into multireciprocity of support relationships among university students, which better matches individual needs and available resources as ties can be anti-aligned across support types. This allowed us to map real-world multilayer support relationships as feature-rich networks and to test the association of reciprocated, multiplex, and especially multireciprocated support rates with career-relevant outcomes.

Our explorative analyses revealed only scattered correlations regarding particular patterns of directed support ties and manifesting almost exclusively in objective performance but less in subjective perceptions. In particular, results showed (1) that being asked for same amounts of career support as sought is related to better grade point averages and that seeking same amounts of subject-related support as asked for is related to lower satisfaction with life. A possible explanation for the link of balanced mutuality regarding career support with better grades is that being sought for career advice does not necessarily mean that someone contemplates their own career plans. Reciprocally seeking career support, however, indicates actively thinking about one's own career and subsequently aligning activities towards career goals. Optimal peer career support seems to require a balanced mutual interaction between peers on equal terms without the need for an expert role. These findings are in line with previous research that has linked students' career planning with better grades (Brown and Lent 2016) due to goal clarity facilitating their achievement (Morisano 2013). As employment as psychologist mostly requires a master's degree and master programs usually require an excellent grade point average (cf. Thiele et al. 2018), obtaining high grades is a necessary requisite to proceed with one's career plans. This, in turn, would increase motivation to achieve good grades (Morisano 2013).

In contrast, to be able to offer sound subject-related support, someone needs to have an in-depth knowledge advantage. Therefore, an exchange on an equal footing could indicate excessive demands as same amounts of needed tutoring are required back. This might result in high levels of stress and perceived pressure to perform well (Ortenburger 2013) expressed in lower life satisfaction. For psychology especially, students from the bachelor's program compete nationwide for only a small number of places for master's programs, resulting in odds of at least 10 applicants per place at the university. Helping other students even though one needs support oneself, could therefore be viewed as time and resources taken away from their own study time or even as helping a rival.

Results showed further, (2) that seeking both socioemotional and career support from one person simultaneously is associated with better grade point averages. In addition to the abovementioned explanations on the benefits of reciprocity in career support, these findings indicate that optimal career support is also characterised by high levels of trust emerging in friendships and close relationships from which one can also receive socioemotional support. Exchanging views on a wide range of topics enhances the quality of relationships (Dutton 2003; Greenhaus and Powell 2006), fosters trust, commitment, and knowing each other which might help supporting in a way that matches specific career planning needs. These findings are in line with multiplexity research, for example, revealing that multiplex developmental relationships from the work- and non-work context (e.g., friend and colleague) are positively associated with actual received career support (Barthauer et al. 2018) and that multiplex ties providing a variety of support types is associated with extraordinary career achievement (Cotton et al. 2011).

Lastly, results showed (3) that seeking career support and being asked for same amounts of socioemotional support in exchange is associated with better grade point averages while the reverse pattern (reciprocating socioemotional with career support) is not. In further addition to the abovementioned explanations on the benefits of reciprocity in career support and its beneficial multiplexity with socioemotional support,

these findings suggest that the balanced anti-aligned exchange of career support with socioemotional support might be beneficial in terms of performance just for one direction. Although such an exchange might enhance trust and friendship within a peer relationship, only receiving these amounts of career support is linked to achieving better grades.

In sum, our exploratory results showed that there might be no general benefit in balance and mutuality in support relationships. However, they indicate that some patterns could be more beneficial in terms of performance than others. Future research should further employ the mutuality perspective (cf. Dobrow et al. 2012) and examine in detail the underlying mechanisms of balanced mutuality in multilayer support networks.

Implications

This study has important theoretical, methodological and practical implications. The results of this study are in line with previous research indicating that there is no one perfect network structure for everyone (Higgins 2007; Liang et al. 2001). Rather, positive outcomes are more likely, when networks are more suited to individual's needs and resources (Higgins 2007). Extending previous research, our findings reveal that multi-reciprocated support in addition to reciprocated and multiplex support could have career (especially performance) enhancing features.

Accordingly, reciprocity and multiplexity alone are not sufficient to study all three types of possible patterns of directed ties. Multireciprocity fills this gap by uncovering anti-aligned ties across network layers. With this study, we opened up a new research topic by transferring new methods of calculations to the field of social network research. While not sufficient as stand-alone methods, each concept, when taken together with related theories, can serve to enhance understanding of social interaction by providing a new array of tools with which to examine network data beyond standard social network analysis tools. Social network research should expand their analyses by taking these ties into account.

The practical implications resulting from this study are manifold: for example, as mutuality in subject-related support is not beneficial, subject-related support may be better provided in unilateral expert situations such as tutorials, mentoring or tandems with high-performing students who do not need subject-related support in exchange. Moreover, as mutual career support has been shown to be particularity important for objective performance, students should be encouraged to exchange career relevant information, assistance, and peer coaching. Therefore, universities could organise events in which such exchanges are encouraged and guided. Moreover, as combined socioemotional and career support might further facilitate performance, emerging relationships should be stabilized in order to establish trust and friendship.

For career counsellors, our findings can be used to map the individual networks of clients by outlining their peer support contacts, which makes them aware of their individual networks. Career counsellors can highlight that support relationships are prone to mutuality and that (multi) reciprocity in (career) support relationships might have positive aspects. By reflecting upon how to optimally align individual network activities, clients could increase the support they gain from peers by simultaneously following the norm of reciprocity.

Limitations and directions for future research

Several limitations should be kept in mind when considering these results. First, this study relied on cross-sectional data. Although our focus explicitly was to explore possible correlations in the first place, the extent of causal interpretations derived from such correlations is limited. Future research should replicate our findings in terms of multi-dimensional peer support mutuality and balance within longitudinal data, in order to determine whether these relationship patterns are predictive for or a consequence of, e.g., performance.

Second, reciprocity, multiplexity, and multireciprocity cannot stand alone. The results obtained in this study, while interesting, are also rather vague and rely on additional information and theories (such as goal setting) to provide interpretational results. Rather than an inherent flaw of either of the three concepts, however, it is more likely a testament to the complexity of social interaction between humans that may elude explanation by only one concept or factor (Chu et al. 2010). For future research, we would therefore recommend that reciprocity, multiplexity, and multireciprocity be supplemented with additional data, such as standard network parameters (e.g., size), the perceived cost of giving or receiving support, or an assessment of fit between a person's needs and their network's resources.

Third, the support relationships examined in this study are relationships of support seeking rather than support giving or support exchange. Strictly speaking, the networks in this study therefore represent the behaviour of (mutual) support-seeking and not the actual exchange of support. However, as the students in this network have been studying together for almost 2 years, they arguably know from whom they will receive support if they ask for it. They would therefore be more likely to approach those peers for help who tend to give it. Also, measuring only support received does not account for unsolicited support, which might be unnecessary or even unwelcome, thus proving to be a stressor rather than a resource (Taylor et al. 2004). Each approach has its own merits and caveats; rather than trying to find "the best" approach, it is more sensible to carefully consider which aspect of support relationships to focus on and weigh the advantages and disadvantages a specific approach will have with regards to results and implications.

Forth, we considered only binary data for analyzing multiplexity although weighted data was available. With current research only indicating that multiplexity needs to be present (e.g., Murphy and Kram 2010) and no indication how balance in weighted multiplexity can be interpreted when it comes to social support relationships, however, binary analyses are a sensible starting point. Future research can and should examine the concept of weighted multiplexity in support relationships. With this study, we hope to provide a starting point for future research, enabling others in our field to employ the methods used by Gemmetto et al. (2016) to address weighted multiplexity.

Finally, we did not compare our observed data to a null model estimating whether the observed data is likely to be coincidental. Although such models exist for the network parameters discussed in this study (cf. Gemmetto et al. 2016; Squartini et al. 2013), we decided against conducting such a complex analysis because we did not assume fundamental coincidences in the data as we measured support seeking by directly asking students belonging to a cohort that existed for over a year already. For future research, however, an implementation of null models could be valuable,

especially when studying newly composed groups of people or when proxy measures (such as e-mails or other technical data) are used to study interpersonal ties.

Conclusion

Summarily, the results of this study point out that there might be no general benefit in reciprocity, multiplexity, and multireciprocity in support relationships. Rather, positive effects emerge for specific constellations of mutuality and support types. With this study, we generate new knowledge on social support exchange by showcasing a new array of tools with which to examine network data. This study thereby might stimulate future research on reciprocity of multiplex social networks.

Additional file

Additional file 1: R syntax and fictitious data set for illustration. (ZIP 3 kb)

Acknowledgements
Not applicable.

Funding
We acknowledge support by the German Research Foundation and the Open Access Publication Funds of the Technische Universität Braunschweig.

Availability of data and materials
The datasets generated and/or analysed during the current study are not publicly available because various publications that are being developed within the research project have not yet been completed but are available from the corresponding author on reasonable request.

Authors' contributions
LT conceived the original idea for the study and gathered the data. VZ performed the analyses. All authors wrote, read, and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

Publisher's Note

Received: 6 November 2018 Accepted: 27 February 2019
Published online: 12 March 2019

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